As per the Latest Syllabus of Anna University, Chennai (Regulation -2017)

Computational Intelligence

For B. Tech VI Semester IT Branch

R.Shalini
P.Krishna Sankar
V.Lathika

ARS PUBLICATIONS
CHENNAI.

PREFACE

This book "Computational Intelligence" is to understand the various characteristics of Intelligent agents and their search strategies. It contributes an impression towards representing knowledge in solving AI problems, reasoning, natural language understand, computer vision, automatic programming and machine learning. It provides a preliminary study to design and implement the different ways of software agents for problem solving.

Unit I: Introduction towards future of Artificial Intelligence and characteristics of Intelligent agents. Outline towards search strategies through Uninformed, Informed and Heuristics along with optimization problems. Summary about the typical expert system and its functional models.

Unit II: Introduction to Proposition logic and First order predicate logic was demonstrated with straight forward and backtracking approach. Awareness towards the ontology and reasoning based on knowledge availability. Demonstrated the Unification, Forward and Backward chaining, Ontological Engineering and Events with Prolog programming.

Unit III: Brief awareness on uncertainty, non-monotonic reasoning, fuzzy, temporal and neural networks.

Unit IV: Contributes a knowledge on learning with understanding towards Bayesian network and Hidden Markov Models. An Illustration on Supervised learning, Decision Tree, Regression, Neural Networks, Support vector machines and Reinforcement learning were briefed in this section.

Unit V: Provides a study over Natural Language Processing and Machine Learning. It provides illustration towards Information extraction, Information retrieval, Machine Translation, Symbol-Based an Connectionist.

Contents

UNIT I

INTRODUCTION

1.1. Introduction to Artificial Intelligence

1.1.1. What is intelligence?

1.1.2. Definition

1.1.3. AI History

1.2. Future of Artificial Intelligence

1.2.1. AI becomes an industry (1980-present)

1.2.2. Return of neural networks (1986-present)

1.2.3. AI adopts scientific method (1987–present)

1.2.4. Emergence of intelligent agents (1995-present)

1.2.5. Availability of very large data sets (2001–present)

1.3. Search Strategies

1.3.1. Infrastructure for search algorithms

1.3.2. Measuring problem-solving performance

1.4. Uninformed Search Strategies

1.4.1. Breadth-first search

1.4.2. Uniform-cost search

1.4.3. Depth-first search

1.4.4. Depth-limited search

1.4.5. Iterative deepening depth-first search

1.4.6. Bidirectional search

1.4.7. Comparing uninformed search strategies

1.5. Informed Search Strategies

1.5.1. Greedy best-first search

1.5.2. A* search: Minimizing total estimated solution cost

1.5.3. Memory-bounded heuristic search

1.6. Heuristics Functions

1.6.1. Effect of heuristic accuracy on performance

1.6.2. Generating admissible heuristics from relaxed problems

1.6.3. Generating admissible heuristics from subproblems: Pattern databases

1.6.4. Learning heuristics from experience

1.7. Game Playing

1.7.1. Optimal Decisions in Games

1.7.2. Alpha - Beta Pruning

1.8. Expert systems

1.8.1. Basic Concept of an Expert System Function

1.8.2. Forward Chaining

1.8.3. Backward Chaining

1.8.4. Designing an Expert Systems

1.8.5. Rule-Based Systems

1.8.6. Deductions in Rule Bases

1.8.7. Characteristics of Expert Systems

1.8.8. Advantages of Expert Systems

1.8.9. Roles in Expert System Development

1.8.10. Applications of Expert System

1.9. Genetic Algorithms

UNIT II

KNOWLEDGE REPRESENTATION AND REASONING

2.1. Proposition Logic

2.1.1. Syntax

2.1.2. Semantics

2.1.3. A simple knowledge base

2.1.4. A simple inference procedure

2.2. First Order Predicate Logic

2.2.1. Represented Revisited

2.2.2. Syntax and Semantics of FIRST-ORDER LOGIC

2.2.3. Using FIRST-ORDER LOGIC

2.2.4. Knowledge Engineering in FIRST-ORDER LOGIC

2.3. Inferences in First Order Predicate Logic

2.3.1. Unification

2.3.2. Forward Chaining

2.3.3. Backward Chaining

2.3.4. Resolution

2.4. Knowledge Representation

2.4.1. Ontological Engineering

2.4.2. Categories and Objects

2.4.3. Events

2.4.4. Mental Events and Mental Objects

2.4.5. Reasoning Systems for Categories

2.4.6. Reasoning with Default Information

2.5. Prolog Programming

2.5.1. Objects and Relationships

2.5.2. Programming

2.5.3. Facts

2.5.4. Questions

2.5.5. Variables

2.5.6. Conjunctions

2.5.7. Rules

2.5.8. Syntax

2.5.9. Characters

2.5.10. Operators

2.5.11. Equality and Unification

2.5.12. Arithmetic

2.5.13. Summary of Satisfying Goals

UNIT III

UNCERTAINTY

3.1. Introduction

3.2. Non-monotonic reasoning

3.2.1. Abductive reasoning

3.2.2. Default reasoning

3.2.3. Circumscription

3.2.4. Implementations: Truth Maintenance Systems

3.3. Fuzzy Logic

3.3.1. Fuzzy Rules

3.3.2. Fuzzy inference

3.4. Temporal logic

3.4.1. Computer applications

3.4.2. Example

3.4.3. Temporal Structures

3.4.4. Temporal reasoning

3.5. Neural networks

3.5.1. Biological Neuron

3.5.2. Working of a Biological Neuron

3.5.3. Model of Artificial Neural Network

3.5.4. Feed-forward Network

3.5.5. Feedback Network

3.5.6. Supervised Learning

3.5.7. Unsupervised Learning

3.5.8. Reinforcement Learning

3.5.9. Applications of Neural Networks

3.6. Neuro-fuzzy inferences

3.6.1. Adaptive Neuro Fuzzy Inference System Architecture

UNIT IV

LEARNING

4.1. Probability basics

4.1.1. Probabilities deals about

4.1.2. Language of propositions in probability assertions

4.1.3. Probability axioms and their reasonableness

4.2. Bayes Rule and its Applications

4.2.1. Applying Bayes’ rule: simple case

4.2.2. Using Bayes’ rule: Combining evidence

4.3. Bayesian Networks

4.3.1. Representing full joint distribution

4.3.2. Conditional independence relations in Bayesian networks

4.4. Exact inference in Bayesian Networks

4.4.1. Inference by enumeration

4.4.2. Variable elimination algorithm

4.4.3. Complexity of exact inference

4.4.4. Clustering algorithms

4.5. Approximate Inference in Bayesian Networks

4.5.1. Direct sampling methods

4.5.2. Inference by Markov chain simulation

4.6. Hidden Markov Models

4.6.1. Simplified matrix algorithms

4.6.2. Hidden Markov model example: Localization

4.7. Forms of Learning

4.7.1. Components to be learned

4.7.2. Representation and prior knowledge

4.7.3. Feedback to learn from

4.8. Supervised Learning

4.9. Learning Decision Trees

4.9.1. Decision tree representation

4.9.2. Expressiveness of decision trees

4.9.3. Inducing decision trees from examples

4.9.4. Choosing attribute tests

4.9.5. Generalization and overfitting

4.9.6. Broadening applicability of decision trees

4.10. Regression and Classification with Linear Models

4.10.1. Univariate linear regression

4.10.2. Multivariate linear regression

4.10.3. Linear classifiers with a hard threshold

4.10.4. Linear classification with logistic regression

4.11. Artificial Neural Networks

4.11.1. Neural network structures

4.11.2. Single-layer feed-forward neural networks (perceptrons)

4.11.3. Multilayer feed-forward neural networks

4.11.4. Learning neural network structures

4.12. Nonparametric Models

4.12.1. Nearest neighbor models

4.12.2. Finding nearest neighbors with k-d trees

4.12.3. Locality-sensitive hashing

4.12.4. Nonparametric regression

4.13. Support Vector Machines

4.14. Statistical Learning

4.15. Learning with Complete Data

4.15.1. Maximum-likelihood parameter learning: Discrete models

4.15.2. Naive Bayes models

4.15.3. Bayesian parameter learning

4.15.4. Learning Bayes net structures

4.16. Learning with Hidden Variables: EM Algorithm

4.16.1. Unsupervised clustering: Learning mixtures of Gaussians

4.16.2. Learning Bayesian networks with hidden variables

4.16.3. Learning hidden Markov models

4.16.4. General form of EM algorithm

4.16.5. Learning Bayes net structures with hidden variables

4.17. Reinforcement Learning

4.17.1. Passive Reinforcement Learning

4.17.2. Active Reinforcement Learning

UNIT V

INTELLIGENCE AND APPLICATIONS

5.1. Natural language processing

5.1.1. Morphological Analysis

5.1.2. Syntax Analysis

5.1.3. Semantic Analysis

5.2. All applications

5.2.1. Business Applications for Natural Language Processing

5.2.2. Role of Natural Language Processing in Healthcare

5.2.3. Natural Language Processing Applications in Finance

5.2.4. Defense and National Security

5.2.5. Natural Language Processing in Recruitment

5.3. Language Models

5.3.1. N-gram character models

5.3.2. Smoothing n-gram models

5.3.3. Model evaluation

5.3.4. N-gram word models

5.4. Information Retrieval

5.4.1. Scoring functions

5.4.2. System evaluation

5.4.3. Refinements

5.4.4. PageRank algorithm

5.4.5. HITS algorithm

5.5. Information Extraction

5.5.1. Finite-state automata for information extraction

5.5.2. Probabilistic models for information extraction

5.5.3. Conditional random fields for information extraction

5.5.4. Ontology extraction from large corpora

5.5.5. Automated template construction

5.5.6. Machine reading

5.6. Machine Translation

5.6.1. Machine translation systems

5.6.2. Statistical machine translation

5.7. Machine Learning

5.7.1. Examples of Machine Learning Applications

5.8. Machine Learning: Symbol-Based

5.8.1. A Framework for Symbol-Based Learning

5.8.2. Version Space Search

5.8.3. ID3 Decision Tree Induction Algorithm

5.9. Machine Learning: Connectionist

5.9.1. Foundations for Connectionist Networks

5.9.2. Perceptron Learning

5.9.3. Backpropagation Learning

View publication stats